onto durable, commercially available drywall carts for storage and/or transportation. This method of storage and transportation makes it very convenient and safe when handling large quantities of modules.

This work was done by Robert Thate of Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-16240-1

Non-Toxic, Low-Freezing, Drop-In Replacement Heat Transfer Fluids

Lyndon B. Johnson Space Center, Houston, Texas

A non-toxic, non-flammable, low-freezing heat transfer fluid is being developed for drop-in replacement within current and future heat transfer loops currently using water or alcohol-based coolants. Numerous water-soluble compounds were down-selected and screened for toxicological, physical, chemical, compatibility, thermodynamic, and heat transfer properties. Two fluids were developed, one with a freezing point near 0 °C, and one with a suppressed freezing point. Both fluids contain an additive package to improve material compatibility and microbial resistance.

The optimized sub-zero solution had a freezing point of –30 °C, and a freezing volume expansion of 10-percent of water. The toxicity of the solutions was experimentally determined as LD_{50} > 5g/kg. The solutions were found to produce "minimal" corrosion with materials identified by NASA as potentially existing in secondary cooling loops.

Thermal/hydrodynamic performance exceeded that of glycol-based fluids with comparable freezing points for temperatures T_f < 20°C. The additive package was demonstrated as a buffering agent to compensate for CO_2 absorption, and to prevent microbial growth. The optimized solutions were determined to have physically/chemically stable shelf lives for freeze/thaw cycles and long-term test loop tests.

This work was done by J. Michael Cutbirth of Mainstream Engineering Corp. for Johnson Space Center. Further information is contained in a TSP (see page 1). MSC-24547-1

Materials That Enhance Efficiency and Radiation Resistance of Solar Cells

John H. Glenn Research Center, Cleveland, Ohio

A thin layer (≈10 microns) of a novel "transparent" fluorescent material is applied to existing solar cells or modules to effectively block and convert UV light, or other lower solar response waveband of solar radiation, to visible or IR light that can be more efficiently used by solar cells for additional photocurrent. Meanwhile, the layer of fluorescent coating material remains fully "transparent" to the visible and IR waveband of solar radiation, resulting in a net gain of solar cell efficiency.

This innovation alters the effective solar spectral power distribution to which an existing cell gets exposed, and matches the maximum photovoltaic (PV) response of existing cells. By shifting a low PV response waveband (e.g., UV) of solar radiation to a high PV response waveband (e.g. Vis-Near IR) with novel fluorescent materials that are transparent to other solar-cell sensitive wavebands, electrical output from solar cells will be enhanced.

This approach enhances the efficiency of solar cells by converting UV and high-energy particles in space that would otherwise be wasted to visible/IR light. This innovation is a generic technique that can be readily implemented to significantly increase efficiencies of both space and terrestrial solar cells, without incurring much cost, thus bringing a broad base of economical, social, and environmental benefits.

The key to this approach is that the "fluorescent" material must be very efficient, and cannot block or attenuate the "desirable and unconverted" waveband of solar radiation (e.g. Vis-NIR) from reaching the cells. Some nano-phosphors and novel organometallic complex materials have been identified that enhance the energy efficiency on some state-of-the-art commercial silicon and thin-film-based solar cells by over 6%.

This work was done by Xiadong Sun and Haorong Wang of Sun Innovations, Inc. for Glenn Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steven Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18781-1.